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Zooplankton of Dauphin Lake, Manitoba; 1982, 1983 and 1984

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TABLE OF CONTENTS

	Page
ABSTRACT/RÉSUMÉ	iv
INTRODUCTION	1
METHODS AND MATERIALS	1
RESULTS AND DISCUSSION	1
Species	1
Abundance and succession of taxa	2
Horizontal distribution	3
Biomass	3
Perspectives	3
CONCLUSIONS	4
ACKNOWLEDGMENTS	4
REFERENCES	4

LIST OF TABLES

Table		Page
1	Sampling schedule and stations sampled for zooplankton of Dauphin Lake, for 1982, 1983 and 1984	7
2	Genera of rotifers and species of crustacean zooplankton collected from Dauphin Lake in 1982, 1983 and 1984	8
3	Some morphometric characteristics and species of crustacean zooplankton found in Dauphin Lake, Methley Ponds, Lake 019, Lake 225, Lake 885, Lake Winnipeg and Ft. Whyte lakes	9
4	Mean density and biomass of crustacean zooplankton of Dauphin Lake during the open water seasons of 1982, 1983 and 1984	10
5	Mean density and biomass of crustacean zooplankton from Dauphin Lake, Erickson pothole lakes and the North and South basins of Lake Winnipeg and Ft. Whyte lakes	11
6	Means and standard deviations of zooplankton densities from regions of Dauphin Lake found to have significant differences	12

LIST OF FIGURES

Figure		Page
1	Location of stations on Dauphin Lake sampled for zooplankton	13
2	Mean temperature of water of Dauphin Lake and cumulative mean density of zooplankton over the sample period.	14
3	Cumulative mean biomass of crustacean zooplankton in Dauphin Lake in 1982, 1983 and 1984	16
4	The relationship between the number of species, the mean depth and the mean epilimnion temperature of fourteen North American great lakes and of Dauphin Lake.	17
5	The relationship between the abundance of the planktonic crustaceans and the mean epilimnion temperature in mid-summer in fourteen North American great lakes and of Dauphin Lake	17
6	The relationship between the biomass of planktonic crustaceans and the mean epilimnion temperature in midsummer in fourteen North American great lakes and in Dauphin Lake	18

LIST OF APPENDICES

Appendix		Page
1	Lengths of zooplankton from Dauphin Lake used to estimate dry weights for biomass estimates	19
2	Statistical information on zooplankton taxa from Dauphin Lake shown in Fig. 2B.	20
3	Statistical information on zooplankton taxa from Dauphin Lake shown in Fig. 2C.	22
4	Statistical information on zooplankton taxa from Dauphin Lake shown in Fig. 2D.	24
5	Statistical information on zooplankton taxa from Dauphin Lake shown in Fig. 2G.	26

ABSTRACT

Friesen, M.K., and J.A. Mathias. 1990. Zooplankton of Dauphin Lake, Manitoba; 1982, 1983 and 1984. Can. Manuscr. Rep. Fish. Aquat. Sci. 2083: iv + 27 p.

Zooplankton in Dauphin Lake, Manitoba were sampled 21 times during the open water seasons in 1982, 1983 and 1984 and once in Feb. 1982. Five copepod species, five cladoceran species and 13 rotifer genera were found. The density and successional patterns for the crustacean zooplankton were similar from year to year. Over the three years the mean density of copepods was 111.2·L^{-1} and for cladocerans it was 8.6·L^{-1}. The mean biomass for the crustacean zooplankton during the open-water season was similar from year to year averaging 64.3 µg (dry weight)·L^{-1}. Although the density of rotifers fluctuated greatly during the season and the successional pattern varied from year to year, the mean density from one year to the next was similar; the overall mean for three years was 200.0·L^{-1}. Dominant copepod species were Diaptomous siciloides, Cyclops bicuspidatus thomasi, Mesocyclops edax and Cyclops vernalis. Dominant cladoceran species were Bosmina longirostris, Diaphanosoma leuchtenbergianum and Daphnia retrocurva. Dominant rotifer genera were Keratella, Polyarthra, and Conochilus. Regional differences in zooplankton distribution occurred only sporodically and may have been caused by wind action. Abundance of cladocerans was low during the time that walleye would be expected to be zooplanktivorous. Comparisons are made between crustacean zooplankton from Dauphin Lake and other lakes and ponds in Manitoba.

Key words: Copepoda; Cladocera; Rotifera; walleye; Stizostedion vitreum; density; biomass.

RÉSUMÉ

Friesen, M.K., and J.A. Mathias. 1990. Zooplankton of Dauphin Lake, Manitoba; 1982, 1983 and 1984. Can. Manuscr. Rep. Fish. Aquat. Sci. 2083: iv + 27 p.

On a échantillonné le zooplancton du lac Dauphin (Manitoba) 21 fois durant la saison des eaux libres en 1982, 1983 et 1984, et une fois en février 1982. On a observé cinq espèces de copépodes, cinq espèces de cladocères et 13 genres de rotifères. L'évolution de la densité et de la succession écologique des crustacés zooplanctoniques était semblable d'une année à l'autre. Pendant les trois années de l'étude, la densité moyenne des copépodes était de 111,2·L^{-1} et la densité moyenne des cladocères était de 8,6·L^{-1}. La biomasse moyenne des crustacés zooplanctoniques durant la saison des eaux libres variait peu d'une année à l'autre; la moyenne était de 64,3 µg (poids sec)·L^{-1}. Bien que la densité des rotifères ait beaucoup fluctué durant la saison et que l'évolution de la succession écologique ait varié d'une année à l'autre, la densité moyenne était semblable d'une année à l'autre; la densité moyenne globale pour les trois ans était de 200,0·L^{-1}. Les espèces dominantes de copépodes étaient Diaptomus siciloides, Cyclops bicuspidatus thomasi, Mesocyclops edax et Cyclops vernalis. Pour ce qui est des cladocères, les espèces dominantes étaient Bosmina longirostris, Diaphanosoma leuchtenbergianum et Daphnia retrocurva. Les genres dominants de rotifères étaient Keratella, Polyarthra et Conochilus. On n'a observé que sporadiquement des différences régionales, qui peuvent avoir été causées par les vents, dans la distribution du zooplancton. L'abondance des cladocères était faible durant la période où le doré est habituellement zooplanctonivore. On a établi des comparaisons entre les crustacés zooplanctoniques du lac Dauphin et d'autres lacs et étangs du Manitoba.

Mots-clés: copépodes; cladocères; rotifères; doré; Stizostedion vitreum; densité; biomasse.

INTRODUCTION

Dauphin Lake, situated in south-western Manitoba (51°17'N 99°48'W), was selected by the Federal Department of Fisheries and Oceans and the Province of Manitoba as the site for research to develop methods for the rehabilitation of walleye fisheries. The only study of zooplankton, essential items in the diet of larval walleye, of Dauphin Lake was conducted in the early 1950's (Stewart-Hay 1951); it consisted of general observations of zooplankton abundance and identification of common species.

Dauphin Lake has a surface area of approximately 522 km², a mean depth of 2.1 meters and maximum depth of 3.5 meters. During the open water season the lake does not stratify thermally and Secchi depth readings rarely exceed 50 cm (Schaap 1987; Babaluk and Friesen 1990a,b). There are seven major inflowing rivers, all located on the west and south shores of the lake and there is one outlet at the north end of the lake. Water from Dauphin Lake eventually flows into Lake Winnipeg.

Walleye in Dauphin Lake usually spawn in late April to early May and eggs hatch in early to mid May; first feeding occurs several days after hatch. Larvae are zooplanktivorous and will die if suitable food in the form of adult copepods, copepodids and cladocerans is not available. The zooplanktivorous period lasts several weeks after which walleye switch to feeding on macrobenthos and fish.

The objective of this study was to identify the zooplankton species and estimate their abundance, horizontal distribution and biomass in Dauphin Lake in 1982, 1983 and 1984. These data are compared to data from several other water bodies in Manitoba, namely, Lake Winnipeg (Patalas 1975, 1981), the Methley fish rearing ponds located on the east shore of Dauphin Lake (Friesen unpublished data), three pothole lakes in southwestern Manitoba near Erickson (Salki 1981) and four artificially made lakes at Ft. Whyte in the southwestern section of the City of Winnipeg (Loadman 1980).

MATERIALS AND METHODS

Zooplankton were collected 21 times during the open water seasons in 1982, 1983 and 1984 (Table 1) and once through the ice in February, 1982. Stations sampled are shown in Fig. 1; not all stations were sampled at each time (Table 1). During the open water season samples were collected with a twin 25 cm diameter Wisconsin net with 73 µm mesh and preserved in 4-10% formalin. During the winter, samples were taken with a single Wisconsin net. Samples were taken by different people over the sampling period and often during the same sampling time. For counting, samples were reduced to 40 mL and a subsample of 0.5 or 1.0 mL removed and counted under a compound microscope. One net from each station from each sampling time was counted. All samples were counted by one person. Identifications for copepods and cladocerans were made to species level using Edmondson (1959) and Pennak (1953) and for rotifers to the genus level using Stemberger (1979).

The horizontal distribution was investigated by comparing densities of zooplankton in different regions of the lake using ANOVA (Steel and Torrie 1980). In the first set of ANOVA tests, comparisons of total numbers of zooplankton, total rotifers, copepods and cladocerans were made between "river mouths" (Stations 2, 13), the "eastshore" (Stations 5, 12, 18), the "south-offshore" (Station 3), the "mid-offshore" (Station 9) and the "north-offshore" (Station 16). In the second set of ANOVA tests, densities of the same taxa were compared for each sampling time in 1982 for different regions of the lake. Regions were the "river mouths" (Stations 1, 2 and 13), the "eastshore" (Stations 5, 12 and 18) and the "offshore" (Stations 3, 4, 6, 8, 9, 10, 14, 15 and 16). Log transformed data were used for the analyses.

Dry weights for biomass estimates were estimated from lengths (Appendix 1) using the formulae of Lawrence et al. (1987). Specimens used for measurements were taken from one station at each sampling time. Subsamples were removed as for counting. All specimens of each taxon, regardless of instar, were measured as they were encountered, up to a maximum of 50 for copepods and 25 for cladocerans. To estimate biomass, the mean number of animals per liter of each group or species at each sampling time was multiplied by the mean dry weight.

RESULTS AND DISCUSSION

SPECIES

A total of 5 copepod species, 5 cladoceran species and 13 rotifer genera were found in Dauphin Lake (Table 2). In general the crustacean species and rotifer genera found in Dauphin Lake are widespread geographically and most, if not all, are found in a wide variety of water body types (Edmondson 1959).

All of the species found in Dauphin Lake are also found in Lake Winnipeg (Table 3). This is expected since water from Dauphin Lake eventually flows into Lake Winnipeg. Dauphin Lake, however, has less than one third of the crustacean zooplankton species found in Lake Winnipeg. Dauphin Lake is shallower than Lake Winnipeg (Table 3), has a surface area about 45

times smaller and does not extend over the same geographic range.

All of the common species in Dauphin Lake are also found in the Methley ponds which is expected since water from the lake is used to fill the ponds. Species found in the ponds but not in the lake were likely introduced from a dugout (Friesen unpublished data). Most of the species found in Dauphin Lake are also common to the prairie pothole (Erickson) lakes. Although Dauphin Lake has a surface area at least 400 times greater than the pothole lakes, it has fewer species of crustacean zooplankton. There may be a number of reasons for this. First, Dauphin Lake has a relatively lower input of allochthonous organic material compared to the pothole lakes based on lake volume. Also, the pothole lakes are bordered by dense strands of aquatic reeds and have an extensive development of submerged aquatic plants; these contribute to higher habitat diversity. In addition, two of the pothole lakes are subject to annual periods of oxygen depletion resulting in occurences of winterkill in Lake 255 and of winterkill and summerkill in Lake 885. Fewer species are found in Lake 019 perhaps because it does not experience winterkill or summerkill; it also has a large population of zooplanktivorous fish. The reason for the similarities in species of copepods and the differences of cladoceran species in Dauphin Lake and the Ft. Whyte lakes (Table 3) is not known. The low number of species in the Ft. Whyte lakes is expected since these lakes have almost no littoral zone, there is little submerged vegetation and there is low habitat diversity.

ABUNDANCE AND SUCCESSION OF TAXA

Rotifers

The mean annual density of rotifers during the open water season was similar among years, the mean for the three year period being 200.0 animals·L^{-1} (Table 4). Rotifer numbers fluctuated greatly and ranged from close to zero in July, 1983, to over 600·L^{-1} in May, 1982 (Fig. 2C, Appendix 2, 3). The high numbers in the spring of 1982 may have been due to rapid warming of the lake (Fig. 2A). The most abundant rotifers in 1982 and 1983 were Keratella sp. and Polyarthra sp. (Fig. 2C). Polyarthra sp. was the only abundant species in 1984. Conochilus had one large peak in 1982 and one in 1983. None of the other genera exceeded a density of 40 specimens·L^{-1}. The density and successional patterns and the genera found here are not unusual for water bodies such as Dauphin Lake (Hutchinson 1967).

Copepods and Cladocerans

The mean density of copepods during the open water season was also similar among years and the mean for the three years was 111.2 animals·L^{-1} (Table 4); the density of copepods over the sampling period ranged from about 20 to 200·L^{-1} (Fig. 2D, Appendix 2, 4). The succession of the different stages of development can be seen clearly in 1982. Nauplii were abundant early in the season. Copepodids increased in abundance in early June followed by a peak in adults in late July. Another peak of nauplii, likely from eggs produced from these adults, occurred in August. The pattern is not as obvious in the following two years, but it appears that the succession does not differ substantially. The timing of the peaks is later in 1983 than in 1982 or 1984 and could have been due to the later ice-off and relatively slower warming of lake water in the spring of 1983.

The most abundant adult copepods were the calanoid, Diaptomous siciloides (Fig. 2F) and the cyclopoids, Cyclops bicuspidatus thomasi and Mesocyclops edax (Fig. 2E). D. siciloides adults were most abundant in February, 1982 and reached the highest numbers of all copepods. In 1982, the number of adult cyclopoids peaked in July (Fig. 2E). In 1983, C. b. thomasi and M. edax peaked at the same time in late July whereas D. siciloides numbers began to increase in early October. In 1984, D. siciloides, C. b. thomasi and M. edax were most abundant at the same time in July and August. Numerous adult D. siciloides were also found in the winter. The bimodal peaks in 1982 and 1984 indicate that the calanoid species may have two generations a year in Dauphin Lake whereas the one peak per year for cyclopoid species indicates one generation per year. Egg-bearing females of C. b. thomasi, M. edax and D. siciloides were present for most of the open water season.

The mean density of cladocerans during the open water season was similar among years and the mean for the three year period was 8.6 animals·L^{-1} (Table 4); density of cladocerans ranged from zero to about 20·L^{-1}. Cladocera did not appear in appreciable numbers until June in all three years (Fig. 2G, Appendix 2, 5).

In all three years numbers of B. longirostris were highest in mid June or early July, declined and then peaked again in early autumn. In 1982 during midsummer when numbers of B. longirostris were low, Diaphanosoma leuchtenbergianum, Daphnia retrocurva and Ceriodaphnia quadrangula reached their highest numbers (Fig. 2G, Appendix 5). A similar pattern occurred in 1983 with other species becoming abundant after the first B. longirostris peak. A different pattern occurred in 1984 with all species being common in late June to early July. The difference in

temperature between years did not seem to affect the time of peak abundance of B. longirostris. The peak in the other species seemed to be advanced in 1984 and may have been related to the early ice-off that occurred in that year. Numbers of Leptodora kindtii were low in all years.

The average annual density of crustacean zooplankton for 1982 is within the range found for Lake 019 and the Ft. Whyte lakes; these lakes all contain zooplanktivorous fish. The mean density for July and August for the three years falls between densities for the north and south basins of Lake Winnipeg for these months (Table 5).

HORIZONTAL DISTRIBUTION

Significant differences ($P<0.05$) in density of rotifers, copepods or cladocerans were not found between regions of the lake when data from selected stations from all three years were compared. In 1982, on six of nine dates tested, there was no significant difference in zooplankton densities in different parts of the lake. On three dates, one 3 weeks after ice-off, and the others during mid-summer, significant differences in zooplankton numbers between regions were observed (Table 6). In one of these cases, during the May 26-28th, 1982 sampling time, the rotifer numbers were at least five times higher on the east shore than at the river mouths or at offshore stations. Since there were no large differences in temperature between different regions on this date (Babaluk and Friesen 1990b) and the lake is subject to mixing by winds, it seems likely that the accumulation of rotifers on this date resulted from wind action and/or resulting currents.

In general the spatial differences found in Lake Winnipeg (Patalas 1981), where distribution of zooplankton appeared to be influenced by inflowing rivers and regional temperature differences, were not found in Dauphin Lake. Differences between inshore and offshore areas were not noted in Dauphin Lake. As can be seen from the means and the differences in standard deviations in Appendix 2, it is apparent that the distribution of zooplankton is not homogenous over the whole lake but one region does not appear to have consistently different densities of animals.

BIOMASS

Mean annual biomass of crustacean zooplankton did not differ greatly between years (Table 4). The mean biomass for crustacean zooplankton for the three year period was estimated to be 64.3 $\mu g \cdot L^{-1}$; biomass ranged from 30 to about 135 $\mu g \cdot L^{-1}$ (Fig. 3A). The mean biomass of Dauphin Lake crustacean zooplankton is considerably lower than that found in the Erickson pothole lakes, except for the shallow part of Lake 019. The pothole lakes, compared to Dauphin Lake, have relatively large shoreline:surface area ratios and have higher inputs of allochthonous organic materials. Lake 019 is the only one of the three pothole lakes studied which, like Dauphin Lake, has fish present year round. The biomass calculated for July and August in Dauphin Lake falls between that found for the north and south basins of Lake Winnipeg and may be related to temperature. This will be discussed further below.

In each of the three years there was one large peak in biomass during the open water season which was made up largely of copepods. Cladoceran biomass peaked at the same time. The shift in peak in 1983 to later in the summer likely occurred because of the late spring ice break-up and slow warming of the lake. It is also possible that the appearance of a later peak in 1983 may be an artifact created by the timing of sampling period. Cyclopoid adults and copepodids made up most of the biomass during the open water season but the calanoid species was the most important component during the winter (Fig. 3B). Although nauplii were usually very abundant, they contributed least to total biomass.

Biomass contributed by cladocerans ranged from zero early in the open water season in all three years to a maximum of 32 $\mu g \cdot L^{-1}$ (Fig. 3C). D. leuchtenbergianum was the largest component of cladoceran biomass.

PERSPECTIVES

It is impossible to say whether the zooplankton fauna has changed since Stewart-Hays survey of 1951 since he describes it in very general terms e.g. "the plankton is moderately abundant everywhere" but we have not found any information which is inconsistent with that found by Stewart-Hay (1951).

Although it is debatable whether Dauphin Lake can be considered to be one of the "great lakes" of North America, it does share most of the characteristics of the "central Canada lakes" described by Patalas (1975) in his study of crustacean zooplankton of fourteen great lakes of this continent. Based on the criteria that Patalas uses for these lakes, Dauphin Lake has more species than expected based on its mean depth (Fig. 4). If mean epilimnion temperature in midsummer is used to predict density and biomass, Dauphin Lake has the expected density of crustacean zooplankton (Fig. 5) and the expected biomass (Fig. 6).

Depending on temperature, walleye larvae usually appear in Dauphin Lake in May and feed

on zooplankton during May and perhaps into early June. Based on the data from this study, it appears that the main food item for walleye during this period would be expected to be copepodids; stomach contents of walleye larvae are needed to confirm this. There is no region of the lake which has consistently higher numbers of edible zooplankton although it appears that high numbers can occur sporodically in some regions. Since these incidences of high numbers are likely due to wind action, and walleye larvae, like rotifers and copepod nauplii, are carried passively by water currents, it seems likely that areas of high zooplankton may also have high numbers of larval walleye.

CONCLUSIONS

Using the criteria described by Patalas (1975) for 14 great lakes of North America, Dauphin Lake has a total density and biomass of crustacean zooplankton expected if the midsummer epilimnetic temperature is considered, but has more species than expected considering the mean depth of the lake. The crustacean zooplankton community structure, species number and density of Dauphin Lake is most similar to the "central Canada lakes" category described by Patalas (1975).

Dauphin Lake also has similarities to other Manitoba lakes. Species numbers of crustacean zooplankton are similar to that found for the Ft. Whyte lakes but lower than that of the Erickson potholes lakes. Compared to the pothole lakes, Dauphin Lake is most similar to Lake 019, the only pothole lake with a year round population of zooplanktivrous fish. Mean annual biomass is also similar to the Ft. Whyte lakes which also have zooplanktivorous fish present year round.

The pattern of rotifer abundance varied considerably but was not unusual for this kind of water body. The density, biomass and successional pattern of copepods and cladocerans were, with a few exceptions, similar in the three years studied. Zooplankton were generally evenly distributed throughout Dauphin Lake but there were times, likely related to wind action, when exceptionally high numbers were found in certain regions. Copepodids would be expected to be the main source of food for newly hatched walleye larvae in Dauphin Lake.

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Table 1. Sampling schedule and stations sampled for zooplankton of Dauphin Lake for 1982, 1983 and 1984.

YEAR	SAMPLING TIME	DATE	NUMBER OF STATIONS SAMPLED	STATIONS SAMPLED
1982	1	Feb. 23,24	9:	A-I, inclusive; Fig. 1A.
	2	May 26,27,28	20:	1-20 inclusive; Fig. 1B.
	3	June 10,11	13:	1-15 inclusive, except 7,8.
	4	June 23,24,25	19:	1-20 inclusive, except 13.
	5	July 8,9	20:	1-20 incl.
	6	July 21,22	20:	1-20 incl.
	7	Aug. 4,5	20:	1-20 incl.
	8	Aug. 17,18,19	19:	1-20 incl. except 10.
	9	Aug.31, Sept.1	20:	1-20 incl.
	10	Sept. 24,25	20:	1-20 incl.
	11	Oct. 19,20	5:	2,3,7,8,9.
1983	12	May 25,26	6:	2,5,13,16,18,20.
	13	June 20,21,22,23	10:	2,3,5,7,9,12,13,16,18,20.
	14	July 18,19	10:	Same as sampling time 13.
	15	Aug. 15,17,18	10:	Same as sampling time 13.
	16	Sept. 26,27,28	4:	5,9,12,16.
1984	17	May 2,3	9:	Same as sampling time 13 except 2.
	18	June 3,5,6	10:	Same as sampling time 13.
	19	July 5,9	2:	1,13.
	20	July 29,30	10:	Same as sampling time 13.
	21	Sept. 6,7	9:	Same as sampling time 13 except 13.
	22	Oct. 2	4:	2,3,5,12.

Table 2. Genera of rotifers and species of crustacean zooplankton collected from Dauphin Lake in 1982, 1983 and 1984. (A) = abundant, (C) = common, (R) = rare.

CRUSTACEA	
Order Eucopepoda	
Cyclops bicuspidatus thomasi Forbes	(A)
Cylops vernalis Fischer	(A)
Diaptomus siciloides Lilljeborg	(A)
Eucyclops agilis (Koch)	(R)
Mesocyclops edax Forbes	(A)
Order Cladocera	
Bosmina longirostris (O.F.M.)	(C)
Ceriodaphnia quadrangula (O.F.M.)	(C)
Daphnia retrocurva Forbes	(C)
Diaphanosoma leuchtenbergianum Fischer	(C)
Leptodora kindtii (Focke)	(R)
ROTIFERA	
cf. *Ascomorpha* sp.	(R)
Asplanchna spp.	(C)
Brachionus cf.*angularis*	(A)
Collotheca spp.	(C)
Conochilus sp.	(C)
Filinia spp.	(C)
Kellicottia sp.	(R)
Keratella cochlearis	(A)
Keratella sp. 1, sp. 2	(C)
Lecane spp.	(R)
Lepodella sp.	(R)
Notholca sp.	(C)
Polyarthra spp.	(A)
Trichocerca sp. 1, sp. 2	(A)
(At least 21 species of rotifers.)	

Table 3. Some morphometric characteristics and species of crustacean zooplankton found in Dauphin Lake [D.], Methley Ponds [M.],(Friesen unpublished data), Lake 019, Lake 225 and Lake 885 (near Erickson, Manitoba) (Salki 1981), Lake Winnipeg [Wpg.](Patalas 1975, 1981) and Fort Whyte lakes [Ft.W](Loadman 1980).

	D.	M.	019	225	885	Wpg.	Ft.W.
Surface area (ha)	5,220	1	29	4	2	245,000	6-13
mean depth (m)	2.1	1.5	3.4	1.6	1.7	12.0	4.3-6.1
maximum depth (m)	3.5	3.7	6.8	2.5	2.9	26.2	10
COPEPODS							
Acanthodiaptomus denticornis	-	-	-	+	-	-	-
Cyclops b. thomasi	+	+	+	+	+	+	+
Cyclops varicans rubellus	-	-	-	+	+	-	-
Cyclops vernalis	+	+	+	+	+	+	+
Cyclops navus	-	+*	-	-	-	-	-
Diaptomus ashlandi	-	-	-	-	-	+	-
Diaptomus clavipes	-	-	-	-	-	+	-
Diaptomus leptopus	-	-	+	+	+	+	-
Diaptomus minutus	-	-	-	-	-	+	-
Diaptomus nudus	-	-	-	+	+	-	-
Diaptomus oregonensis	-	-	-	+	+	+	-
Diaptomus sicilis	-	-	-	-	-	+	-
Diaptomus siciloides	+	+	+	+	+	+	+
Epischura lacustris	-	-	-	-	-	+	-
Epischura nevadensis	-	-	-	-	-	+	-
Eucyclops agilis	+	+	+	+	+	+	-
Limnocalanus macrurus	-	-	-	-	-	+	-
Macrocyclops albidus	-	-	+	+	+	-	-
Mesocyclops edax	+	-	-	-	-	+	+
Tropocyclops prasinus mexicanus	-	-	+	-	-	-	-
TOTAL	5	5	7	11	9	15	4
CLADOCERA							
Alona guttata	-	-	-	-	-	+	-
Alona quadrangularis	-	+	-	+	+	-	-
Alona rectanulata	-	-	+	+	-	-	-
Bosmina longirostris	+	+	+	+	+	+	+
Ceriodaphnia lacustris	-	-	-	-	-	-	+
Ceriodaphnia quadrangula	+	+	-	+	+	+	-
Chydorus sphaericus	-	+	+	+	-	+	-
Daphnia ambigua	-	-	-	-	-	+	-
Daphnia galeata mendotae	-	-	-	-	-	+	+
Daphnia longiremis	-	-	-	-	-	+	-
Daphnia magna	-	-	+	-	+	-	-
Daphnia parvula	-	-	+	+	+	+	+
Daphnia pulex	-	+*	-	-	-	+	-
Daphnia retrocurva	+	+	-	-	-	+	-
Daphnia rosea	-	-	+	+	+	-	-
Daphnia schodleri	-	-	+	+	+	+	-
Diaphanosoma leuchtenberginaum	+	+	+	+	-	+	-
Eurycercus lamellatus	-	-	-	-	-	+	-
Holopedium gibberum	-	-	-	-	-	+	-
Latona setifera	-	-	-	-	-	+	-
Leptodora kindtii	+	+#	-	-	-	+	-
Leydigia quadrangularis	-	-	-	-	-	+	-
Macrothrix laticornis	-	-	+	-	-	-	-
Macrothrix cf. rosea	-	+*	-	-	-	-	-
Pleuroxus denticulatu	-	+*	-	-	-	-	-
Scapholeberis sp.**	-	-	-	-	-	-	+
Sida crystallina	-	-	+	-	-	+	-
Simocephalus vetulus	-	+	-	+	-	+	-
TOTAL	5	11	11	10	6	19	5
TOTAL CRUSTACEAN ZOOPLANKTON SPECIES	10	16	18	21	15	34	9

* Introduced in to the ponds from a farm dugout.
** Found on one occasion in one lake.
# Collected in walleye larvae net.

Table 4. Mean density and biomass of crustacean zooplankton of Dauphin Lake during the open water seasons of 1982, 1983 and 1984.

	MEAN DENSITY: Total #.L-1	Rotifers #.L-1	Copepods #.L-1	Cladocerans #.L-1	BIOMASS: (Cop. and Clad. only) ug.L-1 (dry weight)
1982 (27 May - 25 Sept.)	343.7	240.8	95.7	7.1	53.6
1983 (25 May - 27 Sept.)	291.9	178.4	102.8	10.7	69.3
1984 (2 May - 2 Oct.)	323.8	180.9	135.1	7.9	70.0
Mean	319.8	200.0	111.2	8.6	64.3

Table 5. Mean density and biomass of crustacean zooplankton from Dauphin Lake in 1982, Erickson pothole lakes (Salki 1981) and the North and South basins of Lake Winnipeg (Patalas 1975) and Ft. Whyte lakes (Loadman 1980).

	Dauphin Lake	Pothole lakes						Lake Winnipeg		Ft. Whyte Lakes
		L.885		L. 019		L. 255		North	South	
		Shallow (<1.5m)	Deep 1.5-3.0	Shallow (<1.5m)	Deep 1.5-6.8	Shallow (<1.5m)	Deep 1.5-2.5			
DENSITY (#.L-1)										
Mean annual density (All sampling times)	103.3	286.3	290.6	85.8	126.8	217.7	133.8	-	-	80.5 - 151.4
Mean density during open-water (27 May - 25 Sept.)	102.7	-	-	-	-	-	-	-	-	-
Mean density from June to Aug.	105.7	-	-	-	-	-	-	-	-	-
Mean density during July and August.	95.0	-	-	-	-	-	-	53.3	108.0	-
BIOMASS (ug.L-1) Dry weight										
Mean annual biomass (All sampling times)	59.3	1519*	582*	70*	138*	399*	306*	-	-	-
Mean biomass during open-water (27 May - 25 Sept.)	53.6	-	-	-	-	-	-	-	-	-
Mean biomass from June to Aug.	63.5	-	-	-	-	-	-	-	-	-
Mean biomass during July and August.	70.6	-	-	-	-	-	-	70*	186*	-

* Calculated from wet weight using 7% as the wet weight to dry weight conversion factor (Lawrence et al. 1987).

Table 6. Mean (#.L-1) and standard deviations of zooplankton densities from regions of Dauphin Lake found to have significant differences (P<0.05). Data were log transformed.

DATE	SAMPLING TIME	REGION		GRAND TOTAL	ROTIFERS	COPEPODS	CLADOCERANS
26-May-82	2	River Mouths					
			MEAN	424 B	342 B	80 C	1 A
			STD DEV'N	61	94	45	2
		Eastshore					
			MEAN	2661 A	2199 A	461 A	1 A
			STD DEV'N	319	196	194	2
		Offshore					
			MEAN	325 B	183 B	141 B	0 A
			STD DEV'N	92	85	31	1
09-Jul-82	5	River Mouths					
			MEAN	269 A	200 A	63 AB	6 B
			STD DEV'N	100	67	55	5
		Eastshore					
			MEAN	197 A	164 A	27 B	6 AB
			STD DEV'N	99	98	11	6
		Offshore					
			MEAN	323 A	223 A	82 A	19 A
			STD DEV'N	98	73	24	8
17-Aug-82	8	River Mouths					
			MEAN	303 AB	168 AB	123 A	13 A
			STD DEV'N	144	127	13	6
		Eastshore					
			MEAN	506 A	379 A	123 A	5 B
			STD DEV'N	200	142	72	2
		Offshore					
			MEAN	202 B	108 B	84 A	11 AB
			STD DEV'N	74	51	37	6

The same letter indicates no significant difference (P<0.05) within a taxon between regions at one sampling time. Different letters indicate a significant difference (P<0.05).

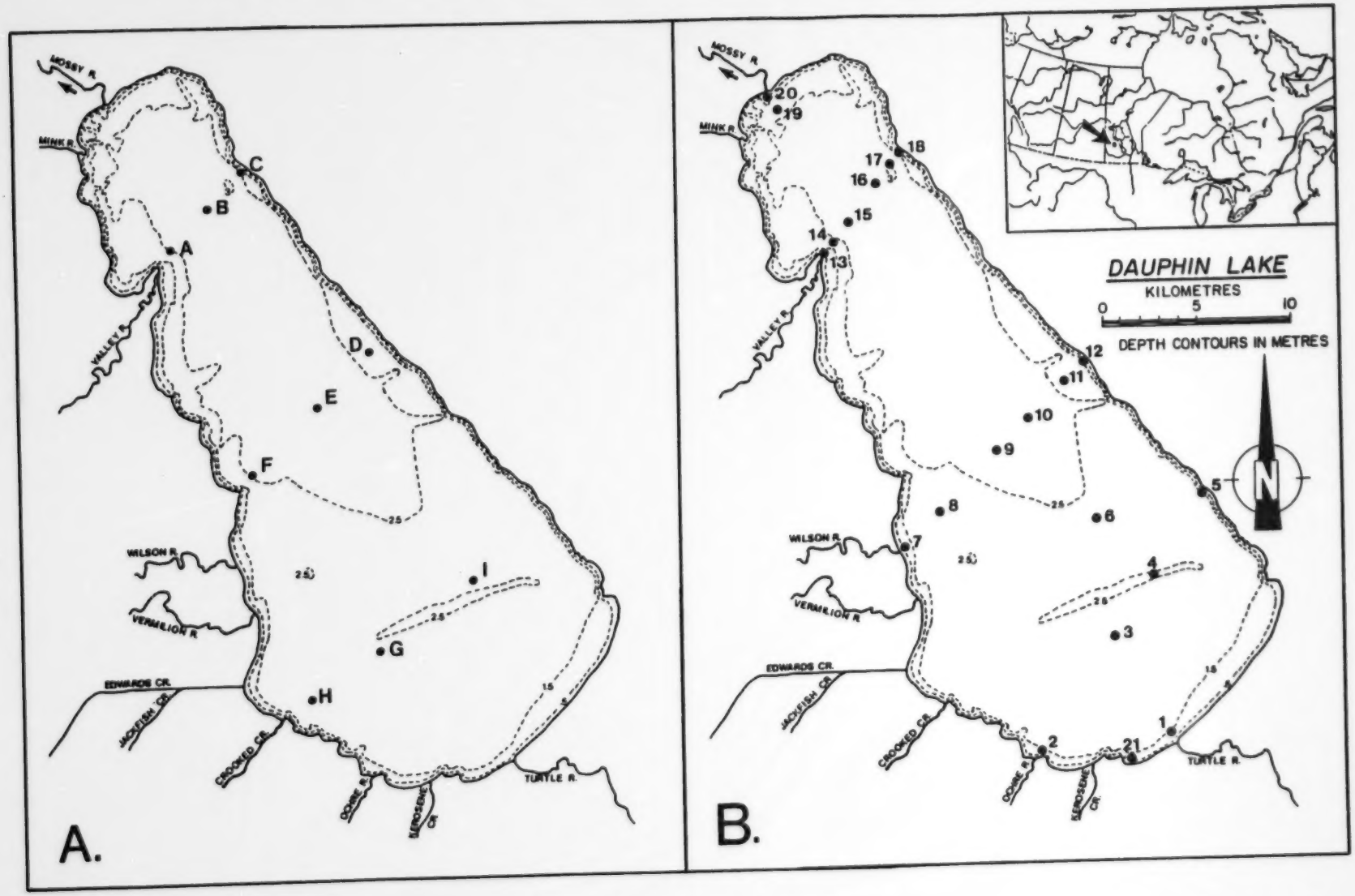
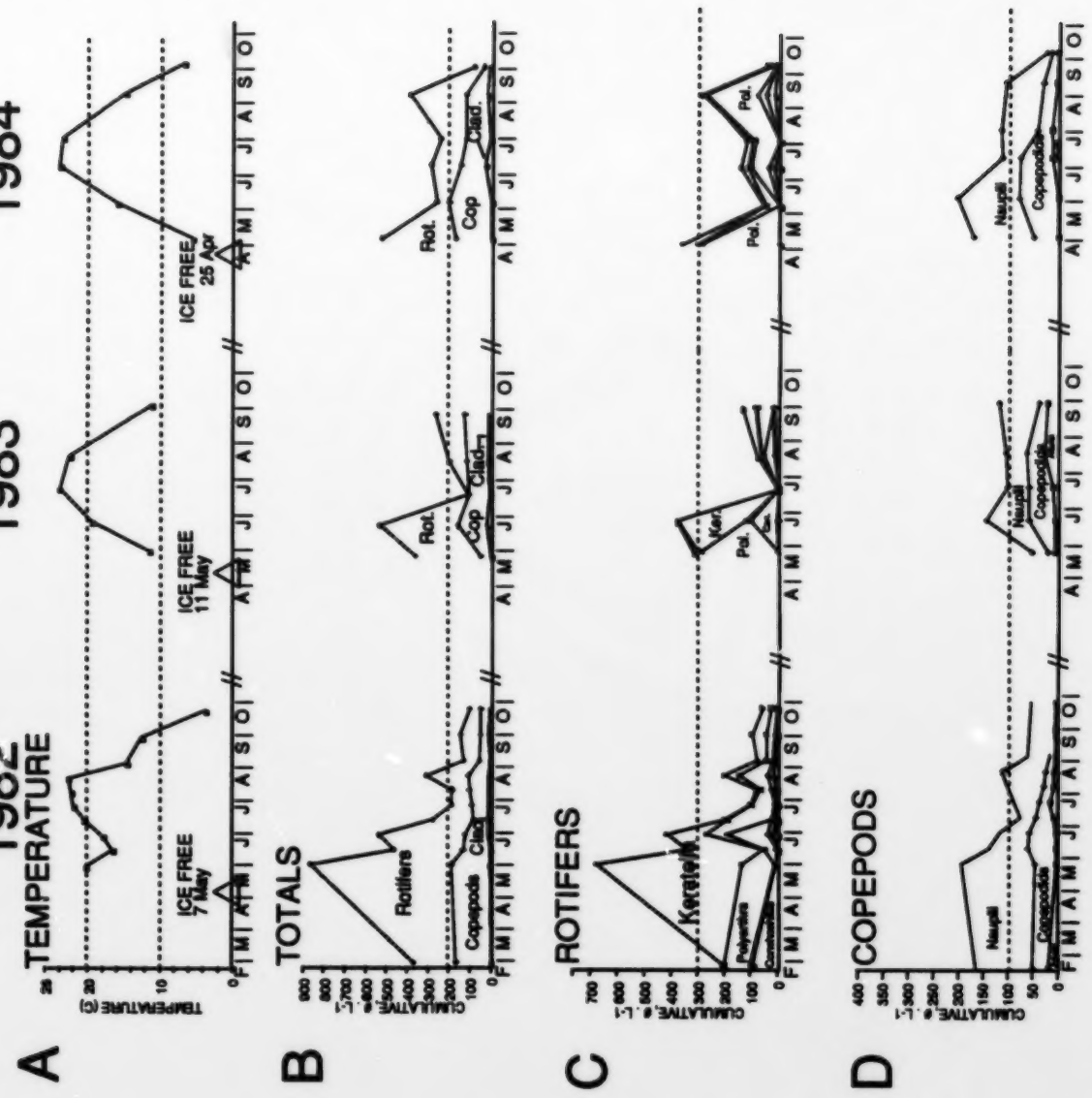


Fig. 1. Location of stations on Dauphin Lake sampled for zooplankton.
A. Stations sampled under ice in Feb. 1982.
B. Stations sampled during the open water season in 1982, 1983 and 1984.


1982
1983
1984
A
TEMPERATURE
TEMPERATURE (C)
ICE FREE
7 May
ICE FREE
11 May
ICE FREE
25 Apr
B
TOTALS
CUMULATIVE # . L-1
Rotifers
Copepods
Clad.
Rot.
Cop
Clad.
C
ROTIFERS
Keratella
Polyarthra
Conochilus
Kell.
Pol.
Con.
D
COPEPODS
Nauplii
Copepodite
Adult
F M A M J J A S O
A M J J A S O

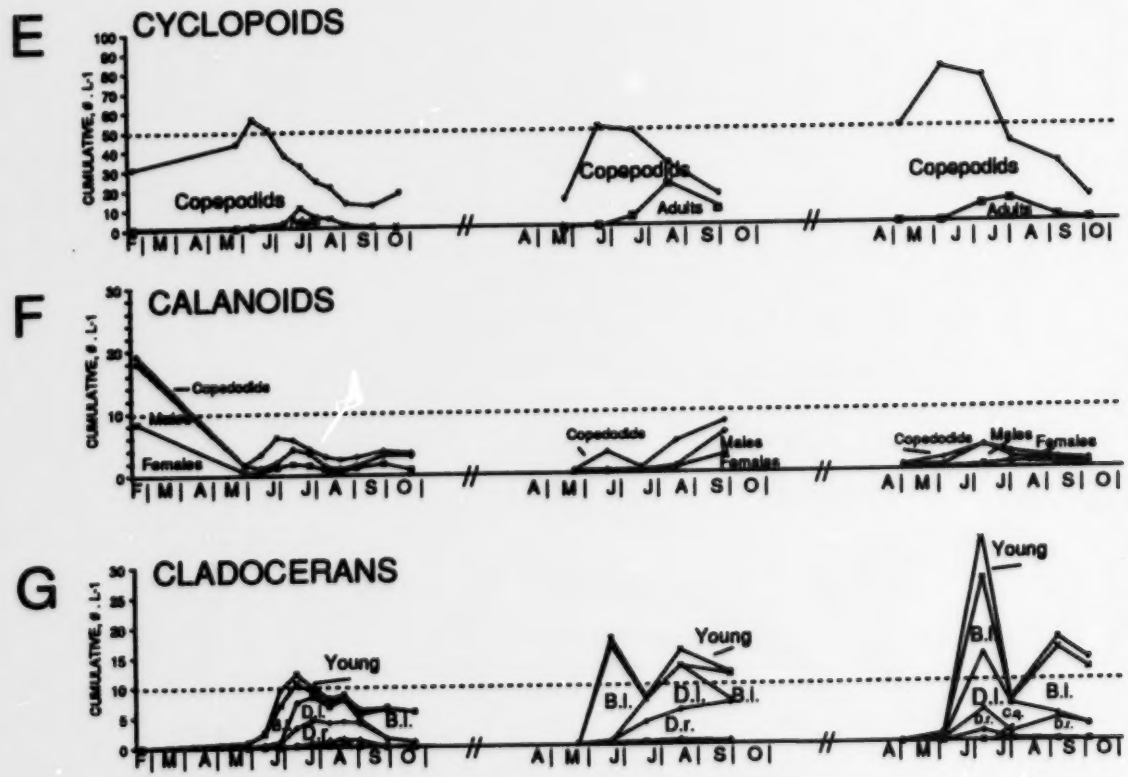


Fig. 2. A. Mean temperature of water of Dauphin Lake at 0.5 and 1.0 m measured at times when zooplankton were sampled.

Cumulative mean density over the sample period of;

B. total of cladocerans, copepods and rotifers;

C. common rotifer genera, Keratella, Polyarthra and Conochilus;

D. copepod adults, copepodids and naupli;

E. cyclopoid adults and copepodids;

F. calanoid adults and copepodids, Diaptomus sicloides;

G. cladocerans, Bosmina longirostris (B.l.), Diaphanosoma leuchtenbergianum (D.l) Daphnia retrocurva (D.r.) and Ceriodaphnia quadrangula (C.q.).

See Appendices 2 - 5, inclusive, for standard deviations and other statistical information on the data presented in B, C, D and G.

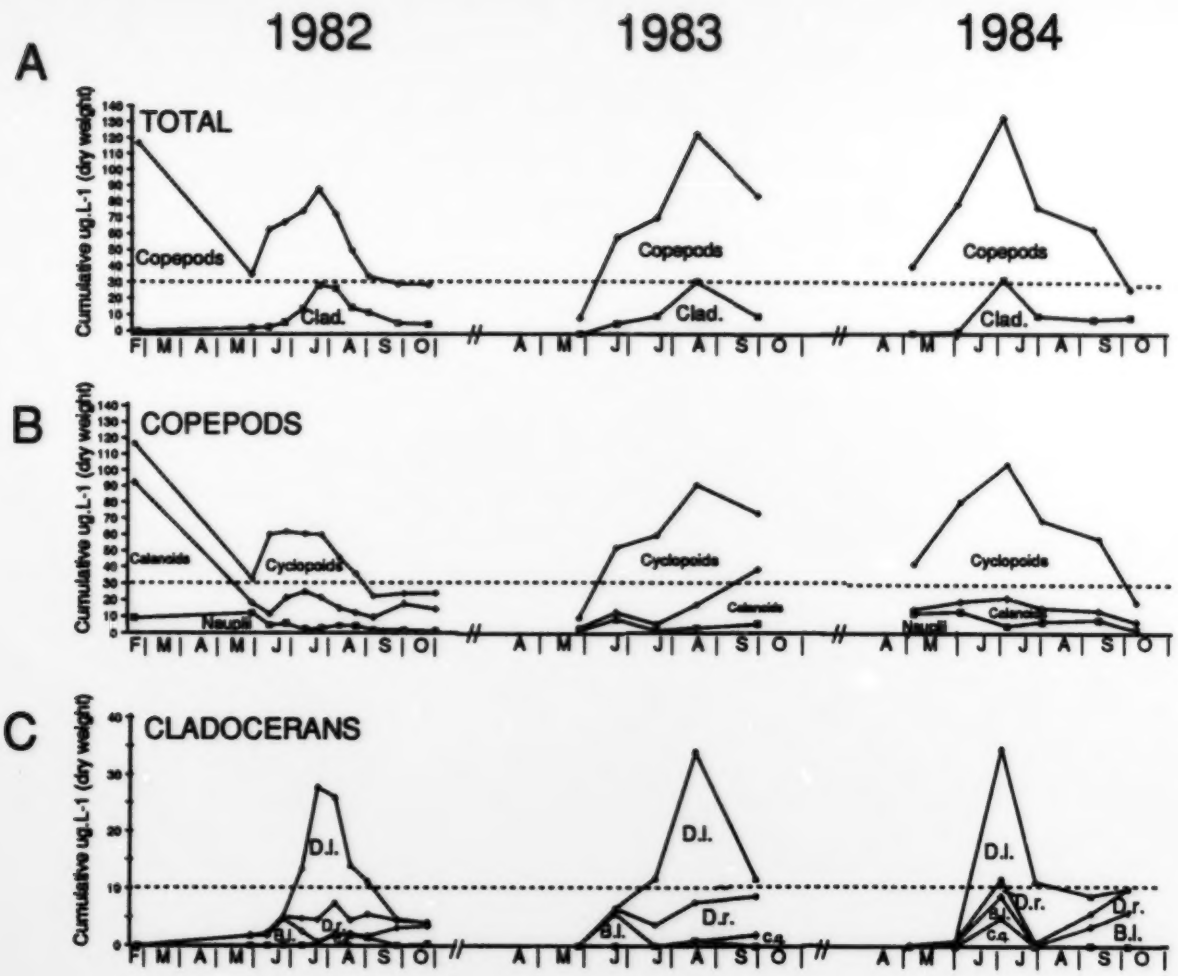


Fig. 3. Cumulative mean biomass of crustacean zooplankton in Dauphin Lake in 1982, 1983 and 1984.

A. Cumulative mean biomass (dry weight) of Copepoda and Cladocera.

B. Cumulative mean biomass (dry weight) of Copepods: naupli, copepodids and adults.

C. Cumulative mean biomass (dry weight) of Cladocerans: Bosmina longirostris (B.l)., Diaphanosoma leuchtenbergianum (D.l.), Daphnia retrocurva (D.r.) and Ceriodaphnia quadrangula (C.q.)

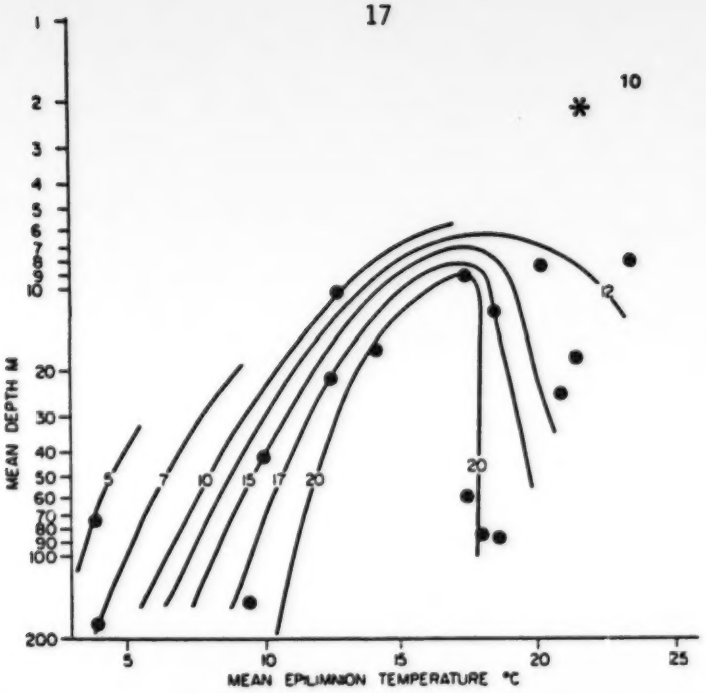


Fig. 4. The relationship between the number of species, the mean depth and the mean epilimnion temperature of fourteen North American great lakes (●) (Patalas 1975) and of Dauphin Lake (*). (Modified from Patalas 1975).

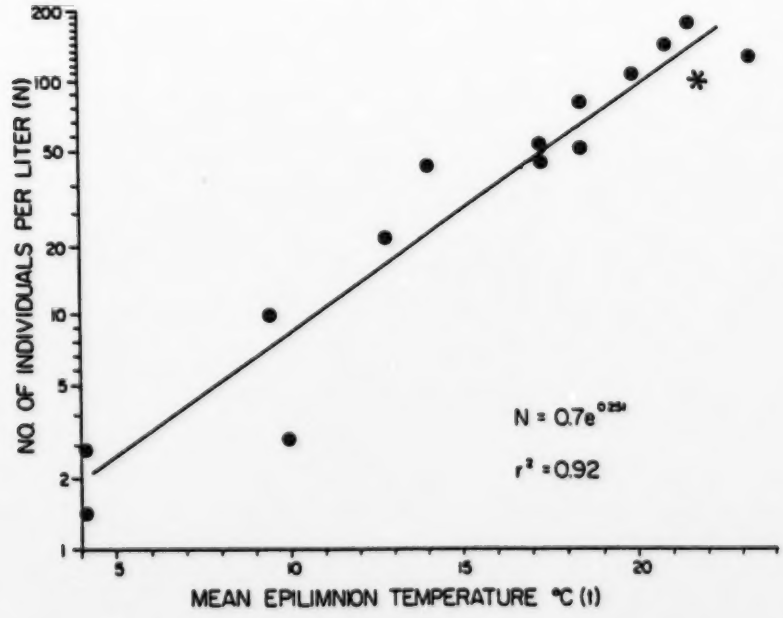


Fig. 5. The relationship between the abundance of the planktonic crustaceans and the mean epilimnion temperature in midsummer in fourteen North American great lakes (●) (Patalas 1975) and of Dauphin Lake (*). (Modified from Patalas 1975).

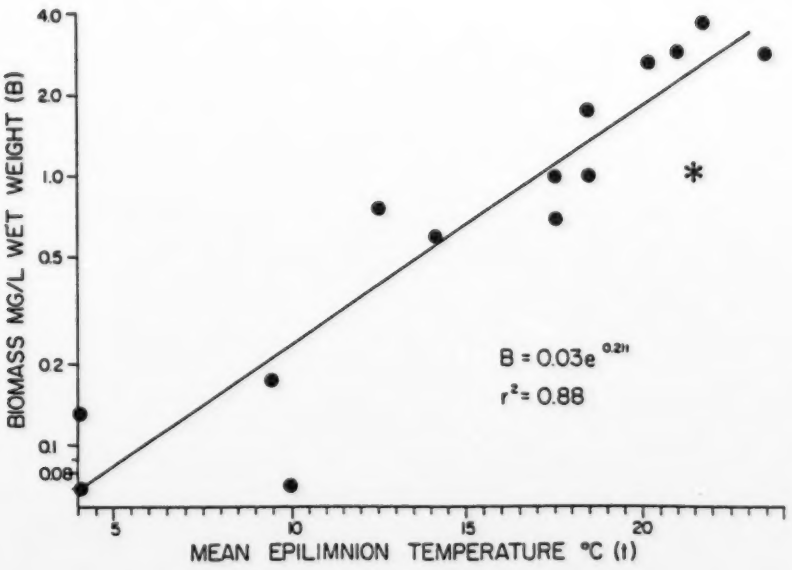


Fig. 6. The relationship between the biomass of planktonic crustaceans and the mean epilimnion temperature in midsummer in fourteen North American great lakes (●) (Patalas 1975) and in Dauphin Lake (*). (Modified from Patalas 1975).

Appendix 1. Lengths (mm) of zooplankton from Dauphin Lake used to estimate dry weights for biomass estimates. Specimens were taken from one station from one sampling time. The number of specimens measured appear in brackets.

		COPEPODA Cyclopoids: Adults and copepodids in mm.	Calanoids: Adults and copepodids in mm.	Copepod Nauplii in mm.	CLADOCERA: Bosmina longirostris	Ceriodaphnia quadrangula	Diaphnanosoma leuchtenbergianum	Daphnia retrocurva
1982	1	0.602 (50)	1.160 (25)	0.167 (50)	-	-	-	-
	2	0.452 (50)	1.110 (25)	0.170 (50)	0.441 (25)	-	-	-
	3	0.633 (50)	0.804 (25)	0.162 (50)	0.373 (25)	-	0.637 (1)	0.946 (1)
	4	0.621 (50)	0.846 (25)	0.188 (50)	0.344 (25)	-	0.612 (6)	0.549 (20)
	5	0.667 (50)	1.117 (25)	0.179 (50)	0.347 (25)	-	0.763 (25)	0.620 (25)
	6	0.723 (50)	1.097 (25)	0.160 (50)	0.278 (25)	0.427 (6)	1.000 (25)	0.713 (25)
	7	0.701 (50)	1.034 (25)	0.159 (50)	0.359 (25)	0.512 (25)	0.998 (25)	0.861 (25)
	8	0.658 (50)	1.020 (25)	0.148 (50)	0.302 (25)	0.459 (25)	0.837 (25)	0.659 (25)
	9	0.639 (50)	0.885 (25)	0.152 (50)	0.291 (25)	0.459 (1)	1.159 (7)	0.735 (25)
	10	0.530 (50)	1.134 (25)	0.162 (50)	0.330 (25)	0.564 (1)	0.996 (1)	0.729 (25)
1983	11	-	-	-	-	-	-	-
	12	0.491 (50)	1.135 (25)	0.149 (50)	-	-	-	-
	13	0.595 (50)	0.674 (25)	0.192 (50)	0.279 (25)	0.368 (1)	0.964 (3)	0.996 (6)
	14	0.698 (50)	1.103 (25)	0.145 (50)	0.356 (25)	0.570 (4)	0.769 (25)	0.705 (25)
	15	0.773 (50)	0.934 (25)	0.187 (50)	-	-	0.878 (25)	0.767 (25)
	16	0.756 (50)	1.120 (25)	0.170 (50)	0.306 (25)	-	1.060 (23)	0.705 (1)
1984	17	0.536 (50)	1.145 (25)	0.183 (50)	0.396 (25)	-	-	0.766 (25)
	18	0.613 (50)	0.967 (25)	0.190 (50)	0.370 (25)	-	0.898 (3)	0.687 (25)
	19	0.725 (50)	1.158 (25)	0.189 (50)	0.373 (25)	0.441 (3)	0.815 (25)	0.693 (25)
	20	0.739 (50)	1.014 (25)	0.174 (50)	0.362 (25)	-	0.754 (25)	0.573 (25)
	21	0.763 (50)	1.040 (25)	0.185 (50)	0.370 (25)	0.446 (5)	0.973 (10)	0.635 (25)
	22	0.649 (50)	1.136 (25)	0.168 (50)	0.328 (25)	-	1.201 (1)	0.801 (25)

Appendix 2. Statistical information on zooplankton taxa from Dauphin Lake shown in Fig. 2B. N = number of stations sampled; TIMES = sampling times (listed in Table 1); GRTOT = Total #.L-1 of rotifers, copepods and cladocerans; TROT = total rotifers; TCOP = total copepods; and TCLAD = total cladocerans.

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN	SUM	VARIANCE	C.V.
TIME=1									
GRTOT	8	370.00	306.98	138.00	746.00	73.03	2960.00	42888.29	55.83
TROT	8	203.88	184.80	51.00	625.00	65.34	1631.00	34150.70	90.64
TCOP	8	166.13	91.77	48.00	377.00	28.91	1329.00	8886.41	49.22
TCLAD	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
TIME=2									
GRTOT	20	865.05	989.67	209.00	3049.00	221.08	17301.00	977377.73	114.29
TROT	20	678.15	887.96	74.00	3877.00	198.55	13523.00	788477.71	131.33
TCOP	20	188.10	144.35	49.00	685.00	32.28	3762.00	20836.20	76.74
TCLAD	20	0.80	1.36	0.00	5.00	0.30	16.00	1.85	170.14
TIME=3									
GRTOT	13	464.92	193.46	229.00	876.00	53.68	6044.00	37425.91	41.61
TROT	13	333.77	180.01	114.00	736.00	49.93	4339.00	32404.03	53.93
TCOP	13	128.77	41.87	64.00	214.00	11.64	1674.00	1781.86	32.60
TCLAD	13	2.38	2.38	0.00	7.00	0.66	31.00	5.59	99.15
TIME=4									
GRTOT	19	535.16	514.87	222.00	2575.00	118.12	10168.00	265092.70	96.21
TROT	19	412.16	401.41	147.00	1989.00	92.09	7831.00	161130.25	97.39
TCOP	19	113.47	117.71	35.00	575.00	27.00	2156.00	13855.04	103.73
TCLAD	19	9.53	8.44	0.00	26.00	1.48	181.00	41.49	87.61
TIME=5									
GRTOT	20	278.30	95.41	133.00	483.00	21.33	5526.00	9102.75	34.53
TROT	20	196.55	71.54	100.00	348.00	16.00	3831.00	5117.63	36.40
TCOP	20	67.55	32.99	14.00	125.00	7.38	1351.00	1088.47	48.84
TCLAD	20	12.20	8.97	0.00	34.00	2.00	244.00	80.38	73.49
TIME=6									
GRTOT	20	189.35	86.44	46.00	355.00	21.58	3787.00	9299.82	50.93
TROT	20	99.05	58.54	28.00	275.00	13.09	1981.00	3428.89	59.10
TCOP	20	80.35	52.00	16.00	182.00	11.63	1607.00	2703.71	64.71
TCLAD	20	9.95	7.39	0.00	29.00	1.65	199.00	53.18	73.24
TIME=7									
GRTOT	20	183.30	64.49	85.00	312.00	14.42	3684.00	4158.80	35.20
TROT	20	80.80	38.73	22.00	180.00	8.66	1616.00	1500.36	47.94
TCOP	20	94.40	36.41	37.00	183.00	8.14	1888.00	1325.73	38.57
TCLAD	20	8.00	5.60	0.00	18.00	1.38	160.00	31.37	70.01
TIME=8									
GRTOT	19	367.26	188.91	86.00	724.00	41.90	9838.00	32727.43	58.88
TROT	19	198.58	156.65	37.00	623.00	35.94	3782.00	24539.37	78.49
TCOP	19	99.00	51.08	33.00	219.00	11.72	1881.00	2609.22	51.60
TCLAD	19	8.68	5.05	2.00	21.00	1.50	165.00	31.89	85.03
TIME=9									
GRTOT	20	128.15	74.38	17.00	252.00	16.63	2563.00	5533.93	58.05
TROT	20	73.95	50.25	11.00	199.00	11.24	1479.00	2525.42	67.96
TCOP	20	48.05	29.98	5.00	104.00	6.70	961.00	898.89	62.40
TCLAD	20	6.15	6.24	0.00	21.00	1.40	123.00	38.98	101.51
TIME=10									
GRTOT	20	143.45	80.98	48.00	396.00	13.84	2869.00	3718.78	42.91
TROT	20	95.00	46.31	33.00	208.00	10.36	1900.00	2144.74	48.75
TCOP	20	41.90	29.23	11.00	86.00	4.53	838.00	409.25	69.78
TCLAD	20	6.55	6.59	0.00	29.00	1.47	131.00	43.42	100.60
TIME=11									
GRTOT	5	101.20	22.88	78.00	129.00	10.23	506.00	523.70	22.61
TROT	5	54.60	18.85	41.00	84.00	8.34	274.00	347.78	34.03
TCOP	5	40.60	8.78	29.00	53.00	3.92	203.00	76.80	21.59
TCLAD	5	6.00	5.36	3.00	15.00	2.36	30.00	27.70	90.74

Appendix 2. Cont'd.

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN	SUM	VARIANCE	C.V.
TIME=12									
GRTOT	6	363.17	316.78	53.00	867.00	129.32	2179.00	99716.17	86.95
TROT	6	315.50	295.44	33.00	840.00	120.61	1893.00	87288.30	93.64
TCOP	6	47.67	62.13	6.00	173.00	25.36	286.00	3859.87	130.34
TCLAD	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.
TIME=13									
GRTOT	10	534.80	485.24	211.00	1766.00	147.12	5348.00	218452.82	86.99
TROT	10	378.10	352.71	158.00	1330.00	111.54	3781.00	124403.21	93.28
TCOP	10	140.10	100.58	30.00	370.00	34.65	1401.00	12008.77	78.22
TCLAD	10	16.60	19.58	1.00	66.00	6.19	166.00	383.38	117.95
TIME=14									
GRTOT	10	110.70	68.84	13.00	194.00	21.77	1107.00	4738.68	62.18
TROT	10	6.30	3.09	2.00	13.00	0.98	63.00	9.57	49.10
TCOP	10	97.10	65.41	0.00	178.00	20.69	971.00	4278.99	67.37
TCLAD	10	7.30	7.07	0.00	24.00	2.24	73.00	50.01	96.87
TIME=15									
GRTOT	10	198.20	118.92	99.00	432.00	37.61	1982.00	14143.07	60.00
TROT	10	83.70	91.37	15.00	280.00	28.89	837.00	8348.01	109.16
TCOP	10	99.90	39.20	59.00	173.00	12.40	999.00	1536.09	39.24
TCLAD	10	14.60	10.34	3.00	32.00	3.24	146.00	106.93	70.16
TIME=16									
GRTOT	4	285.00	182.49	99.00	459.00	91.24	1060.00	33302.00	88.88
TROT	4	140.00	116.42	50.00	299.00	58.21	560.00	13554.00	83.16
TCOP	4	114.00	108.55	43.00	277.00	54.78	456.00	12001.33	86.10
TCLAD	4	11.00	10.68	5.00	27.00	5.34	44.00	114.00	97.08
TIME=17									
GRTOT	9	526.33	247.95	128.00	885.00	82.65	4737.00	61477.00	47.11
TROT	9	357.78	181.42	103.00	591.00	60.47	3220.00	32913.44	50.71
TCOP	9	168.44	94.34	25.00	321.00	31.45	1516.00	8900.28	56.01
TCLAD	9	0.11	0.33	0.00	1.00	0.11	1.00	0.11	300.00
TIME=18									
GRTOT	10	282.10	185.37	97.00	684.00	52.29	2821.00	27348.32	63.09
TROT	10	58.00	61.25	0.00	198.00	19.37	580.00	3751.51	104.17
TCOP	10	202.10	146.72	84.00	598.00	46.40	2021.00	21538.10	72.60
TCLAD	10	1.20	1.55	0.00	4.00	0.49	12.00	2.40	129.10
TIME=19									
GRTOT	3	289.00	35.36	264.00	314.00	25.80	578.00	1250.00	12.23
TROT	3	143.50	24.75	126.00	161.00	17.50	287.00	612.50	17.25
TCOP	3	112.00	60.81	69.00	195.00	43.00	224.00	3698.00	54.30
TCLAD	3	33.50	0.71	33.00	34.00	0.50	67.00	0.50	2.11
TIME=20									
GRTOT	10	244.10	107.99	101.00	474.00	53.09	2441.00	29190.10	88.78
TROT	10	122.70	84.22	20.00	296.00	26.63	1227.00	7092.23	68.64
TCOP	10	114.70	95.66	37.00	388.00	30.25	1147.00	9150.00	83.40
TCLAD	10	6.70	5.54	0.00	20.00	1.75	67.00	30.68	82.67
TIME=21									
GRTOT	9	393.22	310.55	142.00	1171.00	103.52	3539.00	96439.19	78.97
TROT	9	272.78	246.77	78.00	803.00	82.26	2455.00	60896.44	90.47
TCOP	9	104.11	64.58	47.00	252.00	21.53	937.00	4170.61	62.03
TCLAD	9	16.33	10.71	4.00	31.00	3.57	147.00	114.75	65.58
TIME=22									
GRTOT	4	83.25	48.95	18.00	135.00	24.48	333.00	2396.25	58.80
TROT	4	45.75	28.12	14.00	82.00	14.06	183.00	790.92	61.47
TCOP	4	24.50	29.89	0.00	65.00	14.95	98.00	893.67	122.02
TCLAD	4	13.00	7.35	4.00	22.00	3.67	52.00	54.00	56.53

Appendix 3. Statistical information on zooplankton taxa from Dauphin Lake shown in Fig. 2C. N = number of stations sampled; TIMES = sampling times (listed in Table 1); TROT = Total #.L-1 of rotifers; Bra = Brachionus; Ker = Keratella; Con = Conochilus; Pol = Polyarthra; Tri = Trichocera; Asc = Asplanchna.

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN	SUM	VARIANCE	C.V.
TIME=1									
TROT	8	203.88	184.80	51.00	625.00	65.34	1631.00	34158.70	90.64
BRA	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.
KER	8	0.50	0.53	0.00	1.00	0.19	4.00	0.29	106.80
CON	8	7.38	20.06	0.00	57.00	7.09	59.00	402.55	272.05
POL	8	97.13	85.57	0.00	213.00	30.26	777.00	7322.98	88.11
TRI	8	0.13	0.35	0.00	1.00	0.13	1.00	0.13	262.84
ASC	8	82.88	105.71	3.00	271.00	89.20	743.00	38303.84	210.73
TIME=2									
TROT	20	676.15	887.98	74.00	3977.00	198.55	13523.00	788477.71	131.33
BRA	20	0.95	1.47	0.00	5.00	0.33	19.00	2.16	154.53
KER	20	529.55	750.06	41.00	3767.00	188.73	10571.00	578178.47	163.61
CON	20	1.35	2.41	0.00	8.00	0.54	27.00	5.82	178.58
POL	20	124.05	361.78	4.00	1642.00	80.98	2481.00	130890.79	291.65
TRI	20	0.15	0.67	0.00	3.00	0.15	3.00	0.45	447.21
ASC	20	5.60	11.84	0.00	47.00	2.68	112.00	135.41	207.60
TIME=3									
TROT	13	333.77	180.01	116.00	736.00	49.93	4339.00	32404.03	53.93
BRA	13	0.05	0.00	0.00	1.00	0.25	11.00	0.81	196.21
KER	13	275.23	181.78	87.00	688.00	50.42	3578.00	33047.69	66.05
CON	13	46.54	42.34	2.00	140.00	11.74	605.00	1793.44	90.97
POL	13	3.62	4.15	0.00	14.00	1.15	47.00	17.26	114.90
TRI	13	0.23	0.60	0.00	2.00	0.17	3.00	0.36	259.63
ASC	13	0.23	0.44	0.00	1.00	0.12	3.00	0.19	190.03
TIME=4									
TROT	19	412.16	401.41	147.00	1689.00	92.09	7831.00	161130.25	97.39
BRA	19	10.63	46.27	0.00	207.00	10.62	354.00	2141.38	248.37
KER	19	142.36	183.17	24.00	837.00	42.02	2703.00	33548.88	128.75
CON	19	151.42	127.63	34.00	537.00	29.28	2877.00	16290.37	84.28
POL	19	76.42	98.48	9.00	408.00	22.59	1452.00	9687.87	128.88
TRI	19	10.84	41.14	0.00	185.00	9.44	358.00	1882.47	218.34
ASC	19	0.21	0.94	0.00	3.00	0.12	4.00	0.29	254.27
TIME=5									
TROT	20	198.55	71.54	100.00	348.00	16.00	3931.00	5117.03	36.40
BRA	20	3.80	3.51	0.00	12.00	0.78	76.00	12.31	89.95
KER	20	9.10	8.03	2.00	32.00	1.12	182.00	25.25	55.22
CON	20	0.40	0.68	0.00	2.00	0.13	8.00	0.36	169.56
POL	20	163.85	69.50	72.00	304.00	15.54	3277.00	4829.71	42.41
TRI	20	16.80	12.88	0.00	47.00	2.88	336.00	163.85	76.19
ASC	20	0.20	0.52	0.00	2.00	0.12	4.00	0.27	261.57
TIME=6									
TROT	20	99.05	58.54	28.00	225.00	13.09	1981.00	3426.89	59.10
BRA	20	6.15	8.42	0.00	29.00	1.88	123.00	70.98	136.99
KER	20	4.20	3.91	0.00	16.00	0.88	84.00	15.33	93.21
CON	20	0.10	0.31	0.00	1.00	0.07	2.00	0.09	307.79
POL	20	86.25	55.84	20.00	219.00	12.49	1725.00	3117.78	64.74
TRI	20	1.10	1.21	0.00	4.00	0.27	22.00	1.46	109.96
ASC	20	0.40	0.82	0.00	3.00	0.18	8.00	0.67	205.20
TIME=7									
TROT	20	80.80	38.73	22.00	160.00	8.66	1616.00	1500.38	47.94
BRA	20	18.35	18.67	1.00	78.00	4.18	367.00	348.66	101.76
KER	20	16.75	11.57	3.00	50.00	2.59	335.00	133.78	69.05
CON	20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.
POL	20	38.70	30.80	7.00	127.00	6.89	774.00	948.84	79.59
TRI	20	0.80	1.58	0.00	6.00	0.35	16.00	2.48	197.82
ASC	20	2.95	2.93	0.00	10.00	0.65	59.00	8.58	99.27
TIME=8									
TROT	19	199.58	156.65	37.00	623.00	35.94	3792.00	24539.37	78.49
BRA	19	20.16	10.75	6.00	37.00	2.47	383.00	115.58	53.33
KER	19	49.84	33.87	5.00	142.00	7.77	947.00	1147.36	67.96
CON	19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.
POL	19	107.74	111.72	19.00	434.00	25.63	2047.00	12481.09	103.70
TRI	19	1.42	1.35	0.00	4.00	0.31	27.00	1.81	94.75
ASC	19	18.26	36.65	0.00	162.00	8.41	309.00	1342.87	225.33
TIME=9									
TROT	20	73.95	50.25	11.00	199.00	11.24	1479.00	2525.42	67.96
BRA	20	8.70	11.61	0.00	54.00	2.60	174.00	134.75	133.43
KER	20	30.20	21.04	4.00	72.00	4.70	604.00	442.48	69.65
CON	20	1.20	1.94	0.00	7.00	0.43	24.00	3.75	161.32
POL	20	23.35	19.55	3.00	82.00	4.37	467.00	382.24	83.73
TRI	20	2.40	2.39	0.00	7.00	0.54	48.00	5.73	99.71
ASC	20	6.65	9.50	0.00	33.00	2.13	133.00	90.34	142.93
TIME=10									
TROT	20	95.00	46.31	33.00	208.00	10.36	1900.00	2144.74	48.75
BRA	20	1.15	1.98	0.00	9.00	0.44	23.00	3.92	172.25
KER	20	51.05	19.92	21.00	94.00	4.45	1021.00	396.89	39.02
CON	20	2.40	2.78	0.00	11.00	0.62	48.00	7.73	115.82
POL	20	34.70	24.60	1.00	94.00	5.50	694.00	605.06	70.89
TRI	20	2.25	3.21	0.00	12.00	0.72	45.00	10.30	142.66
ASC	20	1.15	1.87	0.00	7.00	0.42	23.00	3.50	162.74
TIME=11									
TROT	5	54.80	18.65	41.00	84.00	8.34	274.00	347.70	34.03
BRA	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.
KER	5	30.00	11.46	18.00	47.00	5.12	150.00	131.00	38.15
CON	5	1.00	1.00	0.00	2.00	0.45	5.00	1.00	100.00
POL	5	21.20	9.07	11.00	31.00	4.05	106.00	82.20	42.77
TRI	5	0.40	0.55	0.00	1.00	0.24	2.00	0.30	136.93
ASC	5	1.00	1.00	0.00	2.00	0.45	5.00	1.00	100.00

Appendix 3. Cont'd.

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN	SUM	VARIANCE	C.V.
				TIME=12					
TROT	6	315.00	295.44	33.00	840.00	120.61	1893.00	87298.30	93.84
BAA	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.
AER	6	13.00	8.38	2.00	25.00	3.83	78.00	88.00	72.18
CDH	6	0.33	0.82	0.00	2.00	0.33	2.00	0.67	244.95
POL	6	279.67	272.22	13.00	757.00	111.13	1678.00	74105.07	97.34
TRI	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.
ASC	6	4.33	4.68	0.00	11.00	1.91	26.00	21.87	107.91
				TIME=13					
TROT	10	370.10	352.71	158.00	1330.00	111.54	3701.00	124403.21	93.28
BAA	10	1.20	1.62	0.00	4.00	0.51	12.00	2.62	134.84
AER	10	249.30	322.46	70.00	1144.00	101.97	2493.00	103977.79	129.34
CDH	10	95.70	100.81	1.00	317.00	31.88	957.00	10162.46	105.34
POL	10	17.10	35.48	1.00	117.00	11.21	171.00	1257.21	207.35
TRI	10	8.00	14.86	0.00	48.00	4.70	80.00	220.89	185.78
ASC	10	0.40	0.97	0.00	3.00	0.31	4.00	0.93	241.57
				TIME=14					
TROT	10	6.30	3.09	2.00	12.00	0.98	63.00	9.57	49.10
BAA	10	1.40	1.43	0.00	4.00	0.45	14.00	2.04	102.13
AER	10	2.90	3.31	0.00	11.00	1.05	29.00	10.94	132.33
CDH	10	0.70	1.57	0.00	5.00	0.50	7.00	2.46	223.86
POL	10	0.80	1.03	0.00	3.00	0.33	8.00	1.07	129.10
TRI	10	0.70	1.25	0.00	4.00	0.40	7.00	1.57	178.81
ASC	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.
				TIME=15					
TROT	10	83.70	91.37	15.00	280.00	28.89	837.00	8348.01	109.16
BAA	10	16.10	9.86	3.00	35.00	2.86	161.00	81.88	56.70
AER	10	4.40	8.00	0.00	26.00	2.53	44.00	64.04	181.88
CDH	10	37.90	82.66	2.00	269.00	26.14	379.00	6832.32	218.09
POL	10	8.70	5.94	3.00	19.00	1.75	87.00	30.68	63.66
TRI	10	0.70	2.21	0.00	7.00	0.70	7.00	4.90	316.23
ASC	10	0.10	0.32	0.00	1.00	0.10	1.00	0.10	316.23
				TIME=16					
TROT	4	140.00	116.42	50.00	298.00	58.21	560.00	13554.00	83.16
BAA	4	8.00	4.55	3.00	14.00	2.27	32.00	20.67	56.83
AER	4	8.25	7.37	1.00	16.00	3.68	33.00	54.25	89.28
CDH	4	1.50	1.29	0.00	3.00	0.65	6.00	1.67	86.07
POL	4	58.00	53.80	17.00	133.00	26.90	232.00	2894.67	92.76
TRI	4	1.25	1.89	0.00	4.00	0.95	5.00	3.58	151.44
ASC	4	12.25	24.58	0.00	49.00	12.25	49.00	600.25	200.00
				TIME=17					
TROT	9	367.78	181.42	183.00	591.00	60.47	3220.00	32913.44	50.71
BAA	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.
AER	9	13.78	3.99	7.00	19.00	1.33	124.00	15.94	28.98
CDH	9	3.67	9.55	0.00	29.00	3.18	33.00	91.25	260.52
POL	9	308.67	181.10	63.00	557.00	60.37	2590.00	32798.50	63.17
TRI	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.
ASC	9	1.22	2.64	0.00	8.00	0.88	11.00	6.94	215.81
				TIME=18					
TROT	10	98.00	61.25	8.00	198.00	19.37	588.00	3751.51	104.17
BAA	10	1.40	2.55	0.00	7.00	0.81	16.00	6.49	159.21
AER	10	47.40	52.54	4.00	188.00	16.61	474.00	2760.04	110.84
CDH	10	0.50	0.85	0.00	2.00	0.27	5.00	0.72	169.97
POL	10	1.90	2.89	0.00	8.00	0.85	19.00	7.21	141.33
TRI	10	0.30	0.67	0.00	2.00	0.21	3.00	0.46	224.98
ASC	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.
				TIME=19					
TROT	2	143.50	24.75	126.00	161.00	17.50	287.00	612.50	17.25
BAA	2	14.50	20.51	0.00	29.00	14.50	29.00	420.50	141.42
AER	2	10.50	3.54	8.00	13.00	2.50	21.00	12.50	33.67
CDH	2	3.00	2.83	1.00	5.00	2.00	6.00	8.00	94.28
POL	2	65.00	21.21	50.00	80.00	15.00	130.00	450.00	32.64
TRI	2	20.50	0.71	20.00	21.00	0.50	41.00	0.50	3.45
ASC	2	1.00	0.00	1.00	1.00	0.00	2.00	0.00	0.00
				TIME=20					
TROT	10	122.70	84.22	20.00	298.00	26.63	1227.00	7092.23	68.64
BAA	10	12.40	8.08	1.00	19.00	1.92	124.00	36.93	49.01
AER	10	6.40	6.33	0.00	19.00	2.00	64.00	40.04	98.89
CDH	10	1.10	3.14	0.00	10.00	0.99	11.00	9.88	285.72
POL	10	90.60	81.85	16.00	270.00	25.88	906.00	6699.60	90.34
TRI	10	1.70	1.32	0.00	3.00	0.42	12.00	1.73	100.71
ASC	10	0.20	0.63	0.00	2.00	0.20	2.00	0.40	316.23
				TIME=21					
TROT	9	272.78	246.77	78.00	893.00	82.26	2455.00	60896.44	90.47
BAA	9	12.22	9.71	2.00	30.00	2.90	110.00	75.94	71.30
AER	9	12.33	9.57	3.00	30.00	3.19	111.00	91.50	77.56
CDH	9	2.33	3.32	0.00	10.00	1.11	21.00	11.00	142.14
POL	9	199.67	183.30	45.00	657.00	61.10	1797.00	33597.75	98.04
TRI	9	31.00	98.06	4.00	297.00	19.00	267.00	34000.01	185.22
ASC	9	17.00	14.48	0.00	45.00	4.83	181.00	200.01	88.93
				TIME=22					
TROT	4	48.75	28.12	14.00	82.00	14.06	183.00	790.92	61.47
BAA	4	0.25	0.50	0.00	1.00	0.25	1.00	0.25	200.00
AER	4	11.00	8.41	2.00	22.00	4.20	44.00	70.67	76.42
CDH	4	2.00	1.83	0.00	4.00	0.91	8.00	3.33	91.79
POL	4	18.00	10.10	7.00	30.00	5.05	72.00	102.00	56.11
TRI	4	1.75	1.71	0.00	4.00	0.85	7.00	2.92	97.59
ASC	4	13.25	9.98	1.00	24.00	4.97	49.00	98.92	81.19

Appendix 4. Statistical information on zooplankton taxa from Dauphin Lake shown in Fig. 2D. N = number of stations sampled; TIMES = sampling times (listed in Table 1); TCOP = Total #.L-1 of copepods; COPN = nauplii; COPC = copepodids; and COPA = adults.

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN	SUM	VARIANCE	C.V.
TIME=1									
TCOP	8	166.13	81.77	48.00	277.00	28.91	1329.00	6686.41	49.22
COPN	8	110.00	59.08	31.00	193.00	20.89	928.00	3490.00	50.93
COPC	8	31.25	26.09	1.00	72.00	9.22	250.00	680.79	83.49
COPA	8	18.88	13.42	1.00	45.00	4.75	151.00	180.13	71.10
TIME=2									
TCOP	20	188.10	144.35	48.00	685.00	32.28	3762.00	20836.20	76.74
COPN	20	142.85	148.82	30.00	638.00	33.28	2853.00	22147.61	104.33
COPC	20	42.70	32.14	6.00	130.00	7.19	854.00	1032.85	75.26
COPA	20	2.75	3.34	0.00	10.00	0.75	55.00	11.14	121.40
TIME=3									
TCOP	13	138.77	41.87	84.00	214.00	11.84	1674.00	1781.88	32.80
COPN	13	88.15	24.59	31.00	109.00	6.82	889.00	604.64	35.56
COPC	13	56.77	35.16	13.00	137.00	9.75	738.00	1236.03	61.93
COPA	13	2.85	2.78	0.00	10.00	0.77	37.00	7.64	97.12
TIME=4									
TCOP	19	113.47	117.71	35.00	575.00	27.00	2156.00	13855.04	103.73
COPN	19	58.53	91.89	11.00	429.00	21.08	1074.00	8443.82	162.56
COPC	19	54.42	32.34	13.00	141.00	7.42	1034.00	1045.58	59.42
COPA	19	2.53	1.84	0.00	6.00	0.42	48.00	3.37	72.71
TIME=5									
TCOP	20	67.55	32.99	14.00	135.00	7.38	1351.00	1088.47	48.84
COPN	20	24.20	15.48	3.00	75.00	3.46	484.00	239.96	64.01
COPC	20	35.80	18.24	4.00	67.00	4.30	716.00	370.06	53.72
COPA	20	7.55	6.79	0.00	25.00	1.52	151.00	46.18	89.98
TIME=6									
TCOP	20	80.35	52.00	16.00	182.00	11.63	1607.00	2703.71	64.71
COPN	20	44.05	38.49	9.00	140.00	8.61	881.00	1481.52	87.38
COPC	20	21.45	13.17	0.00	57.00	2.95	429.00	173.52	61.41
COPA	20	14.85	14.53	1.00	63.00	3.25	297.00	210.98	97.81
TIME=7									
TCOP	20	84.40	39.41	37.00	183.00	8.14	1688.00	1325.73	38.57
COPN	20	67.15	37.33	33.00	170.00	8.11	1343.00	747.08	40.70
COPC	20	10.00	16.05	3.00	68.00	3.59	382.00	257.53	81.87
COPA	20	7.65	5.30	0.00	16.00	1.19	153.00	28.13	69.34
TIME=8									
TCOP	19	99.00	51.08	33.00	219.00	11.72	1881.00	2609.22	51.60
COPN	19	75.21	47.29	18.00	197.00	10.83	1429.00	2227.40	62.75
COPC	19	16.95	11.57	3.00	44.00	2.66	322.00	133.94	68.29
COPA	19	6.84	4.82	1.00	19.00	1.11	130.00	23.25	70.48
TIME=9									
TCOP	20	48.05	29.88	5.00	106.00	6.70	961.00	898.88	62.40
COPN	20	32.35	23.58	3.00	88.00	5.36	645.00	552.30	72.87
COPC	20	11.90	8.08	2.00	25.00	1.81	238.00	65.36	67.94
COPA	20	3.90	2.83	0.00	11.00	0.63	78.00	7.99	72.48
TIME=10									
TCOP	20	41.80	20.23	11.00	86.00	4.52	836.00	409.25	48.28
COPN	20	26.20	18.42	4.00	83.00	4.34	524.00	377.33	74.14
COPC	20	11.45	8.70	0.00	37.00	1.84	229.00	75.63	75.95
COPA	20	4.25	4.47	0.00	20.00	1.00	85.00	19.99	105.19
TIME=11									
TCOP	5	40.60	8.76	29.00	53.00	3.92	203.00	76.80	21.59
COPN	5	18.80	5.26	15.00	28.00	2.35	94.00	27.70	28.00
COPC	5	18.20	10.83	11.00	35.00	4.49	91.00	100.70	55.14
COPA	5	3.60	2.07	2.00	7.00	0.93	18.00	4.30	57.60

Appendix 4. Cont'd.

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN	SUM	VARIANCE	C.V.
TIME=12									
TCOP	9	47.67	62.13	0.00	173.00	25.38	286.00	3859.87	130.34
COPm	6	32.83	40.78	7.00	115.00	16.65	197.00	1662.97	124.20
COPC	6	13.67	18.65	1.00	51.00	7.61	82.00	347.87	136.47
COPA	6	1.17	2.86	0.00	7.00	1.17	7.00	8.17	244.95
TIME=13									
TCOP	10	140.10	109.98	36.00	370.00	34.85	1401.00	12008.77	78.22
COPm	10	86.70	94.24	13.00	317.00	29.80	867.00	8880.90	108.69
COPC	10	52.80	36.80	9.00	120.00	11.67	528.00	1339.51	69.32
COPA	10	0.80	0.79	0.00	2.00	0.22	8.00	0.49	118.53
TIME=14									
TCOP	10	97.10	65.41	0	178.00	20.68	971.00	4278.99	67.37
COPm	10	43.60	31.37	0	89.00	9.92	436.00	984.04	71.95
COPC	10	48.00	37.84	0	113.00	11.96	480.00	1418.67	78.41
COPA	10	5.50	5.44	0	16.00	1.72	55.00	29.61	98.94
TIME=15									
TCOP	10	99.90	39.20	59.00	173.00	12.40	999.00	1536.99	39.24
COPm	10	42.10	33.91	8.00	120.00	10.72	421.00	1149.88	80.55
COPC	10	35.50	11.87	22.00	57.00	3.58	355.00	122.90	31.18
COPA	10	22.30	13.80	4.00	53.00	4.40	223.00	183.34	82.35
TIME=16									
TCOP	4	114.00	109.55	43.00	277.00	54.78	456.00	12001.33	96.10
COPm	4	81.00	78.69	23.00	196.00	39.35	324.00	6192.67	97.15
COPC	4	17.25	16.64	7.00	42.00	8.32	69.00	276.92	96.47
COPA	4	15.75	16.83	3.00	39.00	8.81	63.00	258.92	101.77
TIME=17									
TCOP	9	168.44	94.34	25.00	321.00	31.45	1516.00	8900.28	56.01
COPm	9	118.89	66.68	15.00	244.00	22.23	1070.00	4446.36	56.09
COPC	9	47.89	38.76	5.00	109.00	12.92	431.00	1502.11	80.93
COPA	9	1.67	1.87	0.00	5.00	0.62	15.00	3.50	112.25
TIME=18									
TCOP	10	202.10	148.72	84.00	599.00	46.40	2021.00	21526.10	72.60
COPm	10	122.50	87.54	23.00	323.00	27.68	1225.00	7663.61	71.46
COPC	10	78.20	60.17	6.00	275.00	25.35	782.00	8427.73	102.52
COPA	10	1.40	1.78	0.00	5.00	0.56	14.00	3.16	126.88
TIME=19									
TCOP	2	112.00	88.81	99.00	155.00	43.00	224.00	3898.00	54.30
COPm	2	35.50	3.54	33.00	38.00	2.50	71.00	12.50	9.98
COPC	2	63.50	61.52	20.00	107.00	43.50	127.00	3784.50	96.89
COPA	2	13.00	4.24	10.00	16.00	3.00	26.00	18.00	32.64
TIME=20									
TCOP	10	114.70	95.66	27.00	389.00	30.25	1147.00	9150.90	83.40
COPm	10	72.10	51.03	22.00	209.00	16.39	721.00	2606.10	71.00
COPC	10	39.10	31.58	5.00	112.00	9.98	391.00	996.99	100.51
COPA	10	13.50	14.99	0.00	48.00	4.74	135.00	224.72	111.04
TIME=21									
TCOP	9	184.11	64.58	47.00	252.00	21.53	937.00	4170.61	82.03
COPm	9	73.00	44.72	35.00	168.00	14.91	657.00	1999.75	61.28
COPC	9	37.33	21.35	10.00	81.00	7.12	246.00	455.75	78.10
COPA	9	3.78	3.38	0.00	9.00	1.13	34.00	11.44	89.55
TIME=22									
TCOP	4	34.50	29.89	0	85.00	14.95	88.00	893.67	122.02
COPm	4	10.50	12.40	0	27.00	6.20	42.00	153.67	118.04
COPC	4	12.25	15.58	0	34.00	7.79	49.00	242.92	127.22
COPA	4	1.75	3.86	0	8.00	1.83	7.00	4.25	117.80

Appendix 5. Statistical information on zooplankton taxa from Dauphin Lake shown in Fig. 2G. N = number of stations sampled; TIMES = sampling times (listed in Table 1); TCLAD = Total #.L-1 of cladocerans; BL = Bosmina longirostris; DL = Diaphanosoma leuchtenbergianum; DR = Daphnia retrocurva; CQ = Ceriodaphnia quadrangula.

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN	SUM	VARIANCE	C.V.
TIME=1									
TCLAD	0	0	0	0	0	0	0	0	.
BL	0	0	0	0	0	0	0	0	.
DL	0	0	0	0	0	0	0	0	.
DR	0	0	0	0	0	0	0	0	.
CQ	0	0	0	0	0	0	0	0	.
TIME=2									
TCLAD	20	0.80	1.36	0	5.00	0.30	16.00	1.85	170.14
BL	20	0.80	1.36	0	5.00	0.30	16.00	1.85	170.14
DL	20	0.00	0.00	0	0.00	0.00	0.00	0.00	.
DR	20	0.00	0.00	0	0.00	0.00	0.00	0.00	.
CQ	20	0.00	0.00	0	0.00	0.00	0.00	0.00	.
TIME=3									
TCLAD	13	2.38	2.36	0	7.00	0.66	31.00	5.59	99.15
BL	13	1.69	1.38	0	4.00	0.38	22.00	1.90	81.40
DL	13	0.08	0.28	0	1.00	0.08	1.00	0.08	380.59
DR	13	0.31	0.48	0	1.00	0.13	4.00	0.23	156.12
CQ	13	0.00	0.00	0	0.00	0.00	0.00	0.00	.
TIME=4									
TCLAD	19	9.53	6.44	0	26.00	1.48	181.00	41.49	67.61
BL	19	6.05	5.02	0	21.00	1.15	115.00	25.16	82.99
DL	19	0.21	0.54	0	2.00	0.12	4.00	0.29	254.27
DR	19	0.58	0.90	0	3.00	0.21	11.00	0.81	155.73
CQ	19	0.16	0.37	0	1.00	0.09	3.00	0.14	237.27
TIME=5									
TCLAD	20	12.30	8.87	0	34.00	2.00	246.00	98.38	73.48
BL	20	3.20	2.84	0	9.00	0.63	64.00	8.06	88.74
DL	20	4.25	5.53	0	24.00	1.24	85.00	30.62	130.20
DR	20	2.95	2.78	0	10.00	0.62	59.00	7.73	94.27
CQ	20	0.15	0.37	0	1.00	0.08	3.00	0.13	244.33
TIME=6									
TCLAD	28	9.95	7.29	0	29.00	1.83	199.00	53.10	73.24
BL	20	0.70	1.08	0	4.00	0.24	14.00	1.17	154.42
DL	20	3.80	4.15	0	16.00	0.93	76.00	17.25	106.58
DR	20	3.00	3.99	0	14.00	0.88	76.00	12.91	94.54
CQ	20	0.45	0.78	0	3.00	0.17	9.00	0.58	168.78
TIME=7									
TCLAD	20	8.00	5.00	0	18.00	1.25	160.00	31.37	70.01
BL	20	0.25	0.44	0	1.00	0.10	5.00	0.20	177.70
DL	20	2.75	2.57	0	8.00	0.58	55.00	6.62	93.55
DR	20	3.10	3.09	0	9.00	0.68	62.00	9.57	99.78
CQ	20	0.80	1.15	0	3.00	0.26	16.00	1.33	143.96
TIME=8									
TCLAD	19	8.68	5.95	2.00	21.00	1.30	165.00	31.89	65.03
BL	19	0.53	0.77	0.00	3.00	0.18	10.00	0.60	146.74
DL	19	3.63	2.81	0.00	10.00	0.60	69.00	6.99	77.81
DR	19	3.05	2.88	0.00	12.00	0.66	58.00	8.27	97.60
CQ	19	1.11	2.26	0.00	10.00	0.52	21.00	5.10	204.31
TIME=9									
TCLAD	20	6.15	6.24	0	21.00	1.40	123.00	38.98	101.51
BL	20	0.70	0.86	0	3.00	0.22	14.00	0.96	129.02
DL	20	0.70	1.13	0	4.00	0.25	14.00	1.27	161.23
DR	20	2.85	3.88	0	14.00	0.87	57.00	15.06	136.29
CQ	20	1.00	1.08	0	3.00	0.24	20.00	1.16	107.61
TIME=10									
TCLAD	20	6.55	6.58	0	20.00	1.47	131.00	43.42	100.60
BL	20	4.90	4.40	0	18.00	0.98	98.00	19.36	89.79
DL	20	0.10	0.31	0	1.00	0.07	2.00	0.09	307.79
DR	20	1.25	1.77	0	7.00	0.40	25.00	3.14	141.87
CQ	20	0.00	0.00	0	0.00	0.00	0.00	0.00	.
TIME=11									
TCLAD	5	5.80	5.26	2.00	15.00	2.35	29.00	27.70	90.74
BL	5	5.00	4.06	2.00	12.00	1.82	25.00	16.50	81.24
DL	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.
DR	5	0.60	1.34	0.00	3.00	0.60	3.00	1.80	223.61
CQ	5	0.20	0.45	0.00	1.00	0.20	1.00	0.20	223.61

Appendix 5. Cont'd.

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN	SUM	VARIANCE	C.V.
TIME=12									
TCLAD	6	0	0	0	0	0	0	0	.
BL	6	0	0	0	0	0	0	0	.
DL	6	0	0	0	0	0	0	0	.
DM	6	0	0	0	0	0	0	0	.
CO	6	0	0	0	0	0	0	0	.
TIME=13									
TCLAD	10	16.80	19.58	1.00	66.00	6.19	168.00	383.38	117.95
BL	10	15.00	17.60	1.00	59.00	5.57	150.00	309.78	117.34
DL	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.
DM	10	0.30	0.67	0.00	2.00	0.21	3.00	0.46	224.98
CO	10	0.10	0.32	0.00	1.00	0.10	1.00	0.10	316.23
TIME=14									
TCLAD	10	7.30	7.07	0	24.00	2.24	73.00	50.01	96.87
BL	10	0.00	0.00	0	0.00	0.00	0.00	0.00	.
DL	10	3.60	3.69	0	8.00	1.17	36.00	13.60	102.44
DM	10	3.10	3.96	0	14.00	1.25	31.00	15.66	127.84
CO	10	0.10	0.32	0	1.00	0.10	1.00	0.10	316.23
TIME=15									
TCLAD	10	14.60	10.24	3.00	32.00	3.24	146.00	104.93	70.16
BL	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.
DL	10	8.90	6.19	0.00	19.00	1.96	89.00	38.32	69.72
DM	10	4.70	4.60	0.00	15.00	1.45	47.00	21.12	97.78
CO	10	0.30	0.48	0.00	1.00	0.15	3.00	0.23	161.02
TIME=16									
TCLAD	4	11.00	10.68	5.00	27.00	5.34	44.00	114.00	97.08
BL	4	4.00	5.35	1.00	12.00	2.68	16.00	28.67	133.85
DL	4	0.50	0.58	0.00	1.00	0.29	2.00	0.33	115.47
DM	4	8.00	6.22	1.00	15.00	3.11	24.00	38.67	103.64
CO	4	0.25	0.50	0.00	1.00	0.25	1.00	0.25	200.00
TIME=17									
TCLAD	9	0.11	0.33	0	1.00	0.11	1.00	0.11	300.00
BL	9	0.11	0.33	0	1.00	0.11	1.00	0.11	300.00
DL	9	0.00	0.00	0	0.00	0.00	0.00	0.00	.
DM	9	0.00	0.00	0	0.00	0.00	0.00	0.00	.
CO	9	0.00	0.00	0	0.00	0.00	0.00	0.00	.
TIME=18									
TCLAD	10	1.20	1.96	0	4.00	0.49	12.00	2.40	129.10
BL	10	0.50	0.97	0	3.00	0.31	5.00	0.94	194.37
DL	10	0.10	0.32	0	1.00	0.10	1.00	0.10	316.23
DM	10	0.30	0.67	0	2.00	0.21	3.00	0.46	224.98
CO	10	0.00	0.00	0	0.00	0.00	0.00	0.00	.
TIME=19									
TCLAD	2	33.50	0.71	33.00	34.00	0.50	67.00	0.50	2.11
BL	2	12.00	8.49	6.00	18.00	6.00	24.00	72.00	70.71
DL	2	9.00	12.73	0.00	18.00	9.00	18.00	162.00	141.42
DM	2	3.50	0.71	3.00	4.00	0.50	7.00	0.50	20.20
CO	2	1.50	2.12	0.00	3.00	1.50	3.00	4.50	141.42
TIME=20									
TCLAD	10	6.70	5.54	0	20.00	1.75	67.00	30.68	82.67
BL	10	0.40	0.52	0	1.00	0.16	4.00	0.27	129.10
DL	10	4.70	4.35	0	16.00	1.37	47.00	18.90	92.50
DM	10	0.90	1.10	0	3.00	0.35	9.00	1.21	122.28
CO	10	0.10	0.32	0	1.00	0.10	1.00	0.10	316.23
TIME=21									
TCLAD	9	10.33	10.71	4.00	31.00	3.57	147.00	114.75	65.58
BL	9	10.56	8.53	1.00	26.00	2.84	95.00	72.78	80.82
DL	9	0.67	0.71	0.00	2.00	0.24	6.00	0.50	106.07
DM	9	3.33	3.87	0.00	12.00	1.29	30.00	15.00	116.19
CO	9	0.11	0.33	0.00	1.00	0.11	1.00	0.11	300.00
TIME=22									
TCLAD	4	13.00	7.35	4.00	22.00	3.67	52.00	54.00	56.53
BL	4	9.00	3.56	4.00	12.00	1.78	36.00	12.67	39.54
DL	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.
DM	4	2.50	3.32	0.00	7.00	1.66	10.00	11.00	132.86
CO	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.